eminently the groups in which warning colours are predominant. So, also, the American and Eastern sections of the genus Papilio which are both subjects of mimicry and have all the other characteristics of protected groups with warning colours, are all exquisitely beautiful, with their rich green or crimson spots on a velvety black ground. And if we turn to birds, in which, as there are no known warning colours, all that are not protective are supposed to be due to sexual selection, we find, among much that is beautiful, great numbers of the harshest contrasts and most inharmonious combinations of colour that it is possible to conceive. Such are the blues and yellows and reds of the macaws and of a great number of other parrots; the equally harsh colours of the barbets and the toucans; the contrasted blue and purple or magenta and black of many of the chatterers. In many of these, no doubt, the texture of the surface is so delicate and the colours so bright and pure that we cannot but admire the tints themselves, although it is impossible to claim for the mode in which they are combined even the rudiments of æsthetic beauty. On the other hand, we find really beautiful combinations of colour and marking where sexual selection has certainly not come into play. Such are the exquisite tints and patterns of the cones, cowries, olives, harps, volutes, pectens, and innumerable other molluscan shells; while many of the sea-anemones, and considerable numbers of the caterpillars with warning colours, are equally beautiful.

Still more doubtful and more opposed to reasonable probability is the statement that "our standards of beauty are largely derived from the contemplation of the numerous examples around us, which, strange as it may seem, have been created by the æsthetic preferences of the insect world"—alluding, of course, to the colours and structures of flowers as being due to the need of attracting insects to fertilize them. Here objection may be taken, first, to the term *preferences* as applying to mere beauty in the flower, and still more emphatically to the term *æsthetic*, which there is not a particle of evidence for believing to enter at all into an insect's very limited mentality. Insects visit flowers wholly and solely, so far as we know, to obtain food or other necessaries of their existence, and every fact connected with the colours of flowers can be explained as due to the advantage of conspicuousness amid surrounding foliage, and distinctness from other flowers which are especially suited to different species of insects. When cows and horses refuse to eat the acrid buttercup, we do not say that the glaring yellow colour is repugnant to their æsthetic sensibilities, and that their dislike to the plant as food is the result; yet this would be less improbable than that bees and butterflies have any admiration of or liking for flowers independent of the supply of their physical wants. Moreover, a large part of the beauty *we* see in flowers is independent of colour, and is due to the graceful forms of individual flowers, their elegant groupings, and their charming contrast to the foliage which surrounds them. We now know that much of the variety in the form and position of flowers is dependent on their own physical needs, the protection of the pollen and the germ from rain, wind, or insect enemies, and that it has been produced by natural selection acting under the limitations due to the fundamental laws of vegetable growth. The purity and intensity of the colours are due to the fact that such colours offer a greater contrast to the ever-varying tints of foliage, twig, and bark, seen under constant modifications of light and shade, than would be offered by more sober hues; and thus it is that flowers usually exhibit the purest and brightest colours, which, combined with their elegant or curious forms, and the exquisite setting of green foliage which surrounds them, produce a general effect which is to us inexpressibly charming. But we have no reason to believe that any of the lower animals are affected in the smallest degree by these truly æsthetic feelings, and the use of the term as applied to them is simply begging the question, and is, therefore, not scientific.

It is because Mr. Poulton himself admits that the theory of sexual selection is still to some extent *sub judice* that the preceding remarks have been made in the way of protest against the use of terms which themselves tend to prejudge the case. In his chapters on this subject he has brought many arguments in its favour, some of which are ingenious and novel; but they all appear to rest on very slender evidence or to admit of another interpretation. They will, however, be useful as an incitement to further observation on this most interesting question, which, in all probability, will not be finally settled by the present generation of naturalists.

The book is well illustrated by numerous excellent woodcuts and a coloured plate, and there appear to be few if any misprints, the only one calling for remark being the placing of the cut at p. 34 upside down, so that the resemblance to a catkin is lost. Mr. Poulton is to be congratulated on having produced so readable and suggestive a volume on one of the most attractive departments of natural history, and on having by his own researches contributed so largely to the solution of some of the more interesting problems which it presents.

ALFRED R. WALLACE.

A HAND-BOOK OF ASTRONOMY.

Hand-book of Astronomy. Parts II. and III. By George F. Chambers, F.R.A.S. (Oxford: Clarendon Press, 1890.)

IN commenting upon the first part of this revised edition of Mr. Chambers's "Descriptive and Practical Astronomy," we pointed out the utter insufficiency of the portion devoted to the study of the sun, inasmuch as it left solar spectroscopy altogether out of consideration. Such an arrangement is a breach in the continuity of scientific inquiry, and a grievous fault in a hand-book that makes some pretence to give facts in historical sequence.

The second volume deals with instrumental and practical astronomy, and in it we find spectroscopical astronomy interpolated; the work that has been done in this direction following the description of the instruments employed. This circumstance, however, at once exhibits an inconsistency, for, if spectroscopy properly follows a description of the spectroscope, then telescopy should follow a description of the telescope; whereas in the former volume the aspects of the heavenly bodies were described, and in this the instruments by means of which they are observed.

A cause for the omission of all spectroscopic information from the sections to which it respectively and properly belongs, and its relegation to a couple of chapters in another volume, would be difficult to find. To these chapters, however, for which Mr. Maunder, of Greenwich Observatory, is made responsible, all matters spectroscopical have been referred, and so far as space permitted, Mr. Maunder has furnished a very comprehensive summary of the subject he had in hand ; hence it may be that Mr. Chambers has acted wisely in intrusting the discussion of spectroscopic labours to a practical man. But the first duty of the compiler of such a volume as the one before us is to chronicle facts without comment or bias, and to lay before his readers the conclusions that have been drawn from them, leaving them to stand or fall on their own merits. This, however, has not been done ; many observations are introduced with disparaging remarks, and conclusions deduced from them are said to be "most ingenious, but far from satisfying," without any evidence being adduced of their fallacy.

We also note that the sequence of spectra observed in comets as they approach to or recede from the sun, and supporting the meteoritic origin of these bodies, is mildly objected to. The shift in the position of the citron comet band, which admits of a ready explanation when the masking effect of the first flutings of manganese and lead is considered, is questioned, and the sequence is said to be

> "partly founded on discrepancies as to the positions of some of the bands, which may prove to be significant but which, more probably, are simply due to the difficulties of observation, and partly to the fact that the yellow band of the carbon series in cometary spectra does not always show the same exact correspondence with the carbon band as do those in the green and blue. In particular, it shows at times two or more maxima within its borders, and its redward edge is rather diffused. The positions of these maxima are variously given, but appear to be about 5570 and 5450. There are not a few instances, also, in which this yellow, or, rather, citron, band has been recorded as having its sole maximum at one or other of these wave-lengths. Lockyer ascribes these divergences to the influence of the flutings of manganese and lead, but, bearing in mind the great difficulty of many of these observations, and that the citron band is much the faintest of the three, it seems scarcely safe at present to draw such an inference."

It is here acknowledged that the citron comet band has not a fixed position in the spectrum, and that its appearance is not always the same. Whether it is safe to conclude that the two maxima at λ 557 and λ 545 are due respectively to the flutings of manganese (558) and lead (546), it is not now our place to discuss. Since, however, the shift is real, it is hardly scientific to assert that the measures of its wave-length given by various observers are discrepancies of observation. Again, it is to be regretted that in the survey of cometary spectra no mention is made of Dr. Huggins's important observations in 1866-67 of "a bright line between *b* and F, about the position of the double line of the spectrum of nitrogen," in the spectrum of each of two small comets that appeared in those years. This is also the position of the chief line in the spectrum of the nebulæ, and suggests the connection that exists between the two bodies.

The standard of excellence deemed necessary to establish a sequence in the spectra of comets, as they approach to or recede from the sun, has not been applied all through the work. We find a table showing in parallel columns the general agreement between the motions of stars in line of sight as measured by Dr. Huggins, Mr. Maunder, and at Rugby. To one unacquainted with instrumental difficulties, the motion of stars in line of sight would appear to be a quantity that may be determined with some accuracy ; but to those who know the pitfalls, by far the greater number of such observations appear worthless, for the accuracy attained in the majority of measurements is not sufficiently fine to allow any reliance to be placed upon them. In many cases a star, according to observation, has been moving towards the earth at the rate of about 50 miles a second, whilst another observation, made, perhaps, two minutes afterwards, indicated that it was receding from the earth with the same velocity. It is hardly just, therefore, to select certain determinations and arrange them in parallel columns to demonstrate the efficiency of the method adopted. At the end of the discussion of these motions, a note occurs on Algol. It is shown that the satellite theory of this star's variability, propounded by Goodricke and developed by Pickering, is supported by the fact that observations of its motion in line of sight, may be divided into groups, which indicate that at one time it is approaching our system, and at another receding from it owing to its orbital velocity. With these results we have nothing to do ; but, if we remember rightly, Prof. Vogel was the first to demonstrate the periodic shift of the F line towards the red and the violet end of the spectrum, and in a communication to the Berlin Academy he gave the elements of the orbit traversed. This being so, it is curious to find that Prof. Vogel's discussion of his photographs has been omitted, although some months intervened between the communication and the publication of this volume, whilst Mr. Maunder's later division of his grievously discrepant observations into groups has been included.

There are a few other points to which we would call the author's attention. In the portion devoted to chronological astronomy, the dates of the commencement of the seasons and their consequent lengths, are given for 1860, the corresponding dates for 1890 being inserted in a footnote. It would have cost but little trouble to substitute the latter times when bringing the book up to date, and no purpose is served by the present arrangement.

A new feature, and one to be commended, is the insertion of plans and specifications for small observatories ; this will doubtless be appreciated by amateur astronomers, since the directions and measurements which accompany them are supposed to be such that any builder of ordinary intelligence will be enabled to undertake the construction. It was hardly necessary, however, to give the description and sketch of an observatory on the tower of a dwelling-house and surrounded by chimneys, such as that possessed by the author. The position is certainly not conducive to accurate observations, and the dome described appears to offer every opportunity for being lifted off by a high wind and deposited in the garden.

But although the first and second volumes of this work possess a few commendable features, the third volume has none. It bears the mark of hurried revision, and stands condemned as one of the most incomplete and incorrect productions of its kind. The title of the volume is "The Starry Heavens," and had it been written a quarter of a century ago might have contained most of the matter that is now given. In the face of this fact, which can be well substantiated, Mr. Chambers remarks, "The contents of the volume have been thoroughly revised and brought up to date, and when necessary extended and re-arranged;" yet the only reference to the important and increasing application of photography to the delineation of nebulæ is that in the case of the nebula in Andromeda: "Mr. I. Roberts has recently obtained photographs of this object which seem to combine the features exhibited by Sir J. Herschel in the engraving appended to his 'Outlines of Astronomy,' with the rifts recorded by Bond."

The curtness with which Mr. Chambers disposes of the long-exposure photographs which mark an era in the progress of astronomy is lamentable, and the comparison of them with previous observations is misleading, for the features shown in the engraving at the end of Sir J. Herschel's "Outlines" were never observed; and if Mr. Chambers has seen the photograph he must have noticed that Bond's rifts are considerably extended, and appear as divisions between masses of nebulous matter sweeping round the nucleus. At any rate a person who had not seen the photograph would scarcely be able to appreciate its beauty from the description.

We do not, of course, wish to say that, since photography has so considerably extended our knowledge of the structure of celestial species, all drawings of them should be discarded. The photographic plate only adds to their value because, by a cumulative effect, it grasps and renders manifest faint light which the eye alone can never appreciate; but this is such an important development that the hand-book in which nebulæ are described and their forms dilated upon without giving it full consideration must be stigmatized as terribly incomplete.

Again, the selection of drawings of nebulæ which Mr. Chambers made for the first edition of this work in 1867, and which is still retained, is not a happy one by the common consent of all observers; and we should have supposed that, since many elementary text-books contain reproductions of some of the photographs of nebulæ, a work of such pretensions as this, in which drawings of nebulæ may be counted by the score, would have had at least one photographic representation of their form to enrich its pages.

Also, with respect to the nebula in Andromeda, Mr. Chambers records: "Huggins has noticed the spectrum to be continuous (though cut off at the red end), and therefore, whatever it is seemingly, it is *not gaseous*." That the spectrum was observed by Dr. Huggins in 1864 to be crossed "evidently either by lines of absorption or by bright lines," and that it has been shown to have the same spectrum as that of a comet at a mean distance from the sun, are matters with which Mr. Chambers is apparently not acquainted. It is good to see it asserted, in an italicized expression however, that the nebula does not consist of gaseous matter.

Following the chapters devoted to star clusters, nebulæ, and the Milky Way, and making up the greater portion of the work, we find catalogues of naked-eye, red, variable, and binary stars, which may be found useful. The indexes to both volumes leave much to be desired; indeed, the author notes that they are not complete by themselves, and are designed for use in connection with the table of contents. The disadvantages of this division are obvious, since reference is rendered unnecessarily difficult, a circumstance which, in the eyes of those accustomed to use works of this character, detracts considerably from its merit. At the end of the third volume a general index to the whole work is inserted which is said to be comprehensive. In this we find the names given of all the minor planets, although in the vast majority of cases the cognomen of these unimportant bodies is only known to the discoverer, and to index them is an utter waste of space. The principle, however, of including what might have been omitted and of omitting what should have been included, seems to have been followed by Mr. Chambers through each of the three volumes. We should advise, therefore, that in the case of a future edition a more careful consideration of what constitutes astronomical progress should be made. If this were done, and the facts were arranged in a rather better order, the compilation would be more useful as a hand-book of astronomy.

ANNALS OF THE MUSEUM OF BUENOS AYRES.

Annales del Museo Nacional de Buenos Aires para dar a conocer los objectos de historia natural nuivos ó poco conocidos conservados en este establecimento. Por German Burmeister, Med. Dr., Phil. Dr., Director del Museo Nacional de Buenos Aires. Entrega decimasexta. (Buenos Aires, 1890.)

THE veteran man of science, Dr. H. Burmeister, of Buenos Ayres, continues to issue the "Annals" of the Museum under his charge with unfailing regularity, and now sends us a copy of the 16th part of this excellent serial. Upon the present occasion he deserts for a while his favourite subject of the fossil animals, which the Argentine Tertiaries produce in such countless abundance and of so strange a character, and gives us an account of a scientific expedition into Patagonia, recently carried out by his son, Sr. Carlos V. Burmeister, one of the assistant naturalists of the Museum.

The scientific staff of the expedition to Patagonia left Buenos Ayres in November 1888, and proceeded by railway to Bahia Blanca, and thence by diligence to Carmen on the Rio Negro, where the rest of the party was assembled. The next point attained was Trelew, the chief town of the Welsh settlement on the Rio Chubut, which is now connected by a railway, 70 kilometres in length, with Port Madryn on the Atlantic. By this route, various additional stores, forwarded direct from Buenos Ayres by steamer, were received, and the Expedition, being fully equipped, finally started for the interior of Patagonia on January 9, 1889. The route taken was up the valley of the Chubut until its junction with its tributary, the Rio Chico, whence the latter was followed to its source in the great Lake Colhue. Although the country surrounding this sheet of water is now utterly devoid of trees of any sort, this was certainly not the case in past times, as